

ABSTRACT

An apparatus for measuring emission time delay during irradiation of targeted samples by utilizing digital signal processing to determine the emission phase shift caused by the sample is disclosed. The apparatus includes a source of electromagnetic radiation adapted to irradiate a target sample. A mechanism generates first and second digital input signals of known frequencies with a known phase relationship, and a device then converts the first and second digital input signals to analog sinusoidal signals. An element is provided to direct the first input signal to the electromagnetic radiation source to modulate the source by the frequency thereof to irradiate the target sample and generate a target sample emission. A device detects the target sample emission and produces a corresponding first output signal having a phase shift relative to the phase of the first input signal, the phase shift being caused by the irradiation time delay in the sample. A member produces a known phase shift in the second input signal to create a second output signal. A mechanism is then provided for converting each of the first and second analog output signals to digital signals. A mixer receives the first and second digital output signals and compares the signal phase relationship therebetween to produce a signal indicative of the change in phase relationship between the first and second output signals caused by the target sample emission. Finally, a feedback arrangement alters the phase of the second input signal based on the mixer signal to ultimately place the first and second output signals in quadrature. Mechanisms for enhancing this phase comparison and adjustment technique are also disclosed.